Studies on the Reproductive Biology of Some Prosobranchs from the Coast of Karachi (Pakistan) Bordering the Northern Arabian Sea. I. Observations on *Planaxis sulcatus* (Born, 1780).

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(1 Text figure)

INTRODUCTION

The breeding habits of the members of the superfamily Cerithiacea (including Planaxidae) have been studied in the past by a number of workers: Bandel (1976), Cannon (1975), D'Asaro (1970), Davis (1967), Desai (1962), Habe (1960), Houbrick (1971, 1973), Lebour (1937, 1945), Natarajan (1957), Pilkington (1974), Ramamoorthi & Natarajan (1973), Wolfson (1969), Yamada & Sankurathri (1977). Three types of larval development (see Thorson, 1946) are shown by members of this superfamily. It is interesting to note that only two species of cerithiaceans are so far reported to be viviparous and both of them belong to the family Planaxidae. These are, *Planaxis sulcatus* from the Persian Gulf (Thorson, 1940) and *P. nucleus* from the Caribbean (Bandel, 1976). The other members of the superfamily either exhibit pelagic larval development or direct development from benthonic egg capsules. *Planaxis sulcatus* from New Caledonia is also known to hatch as small veligers (Risbec, 1935 cited in Bandel, 1976). *Planaxis lineatus,* another species from the Caribbean, was stated by Risbec (1935) to show pelagic larval development.

Nothing is known about the breeding habits of the members of Planaxidae of the northern Arabian Sea. The present paper describes the breeding habits and development of early juvenile shell of *Planaxis sulcatus* from the Karachi coast.

METHODS

Specimens of *Planaxis sulcatus* were collected bimonthly from the rocky shore of Buleji and occasionally from Keamari backwaters, Manora, Paradise Point and Cape Monze. They were maintained in the laboratory in glass bowls of 300 ml capacity. One specimen was placed in one bowl in order to determine the number of juveniles per individual. The newly hatched juveniles were transferred to separate glass bowls containing fresh aerated sea water. No food was provided to the juveniles so hatched. Dimensions of juvenile shells were measured at various stages with an ocular micrometer on a stereoscopic microscope. Illustrations were prepared with a camera lucida.

OBSERVATIONS

Planaxis sulcatus occurs abundantly in the upper littoral zone of the rocky shore of Buleji at a tidal height of 2-3 m. Observations were made mainly on the specimens collected from this site. The embryonic development of this species up to the hatching stage, within the maternal body, was not investigated, and observations recorded here relate to the stage just after hatching. In this species all the developmental stages are passed within the maternal body and the embryos are retained in the pallial duct until they reach the crawling stage, at which they hatch.

Breeding Season: Miniature snails hatched in the laboratory from January to August with a peak in June and July. Almost every specimen of the July sample produced miniature snails. Specimens from Keamari sea-wall and Cape Monze also hatched in the laboratory in July 1976 and January 1977, respectively. No hatching was recorded from September to December although specimens were placed for hatching during this period.

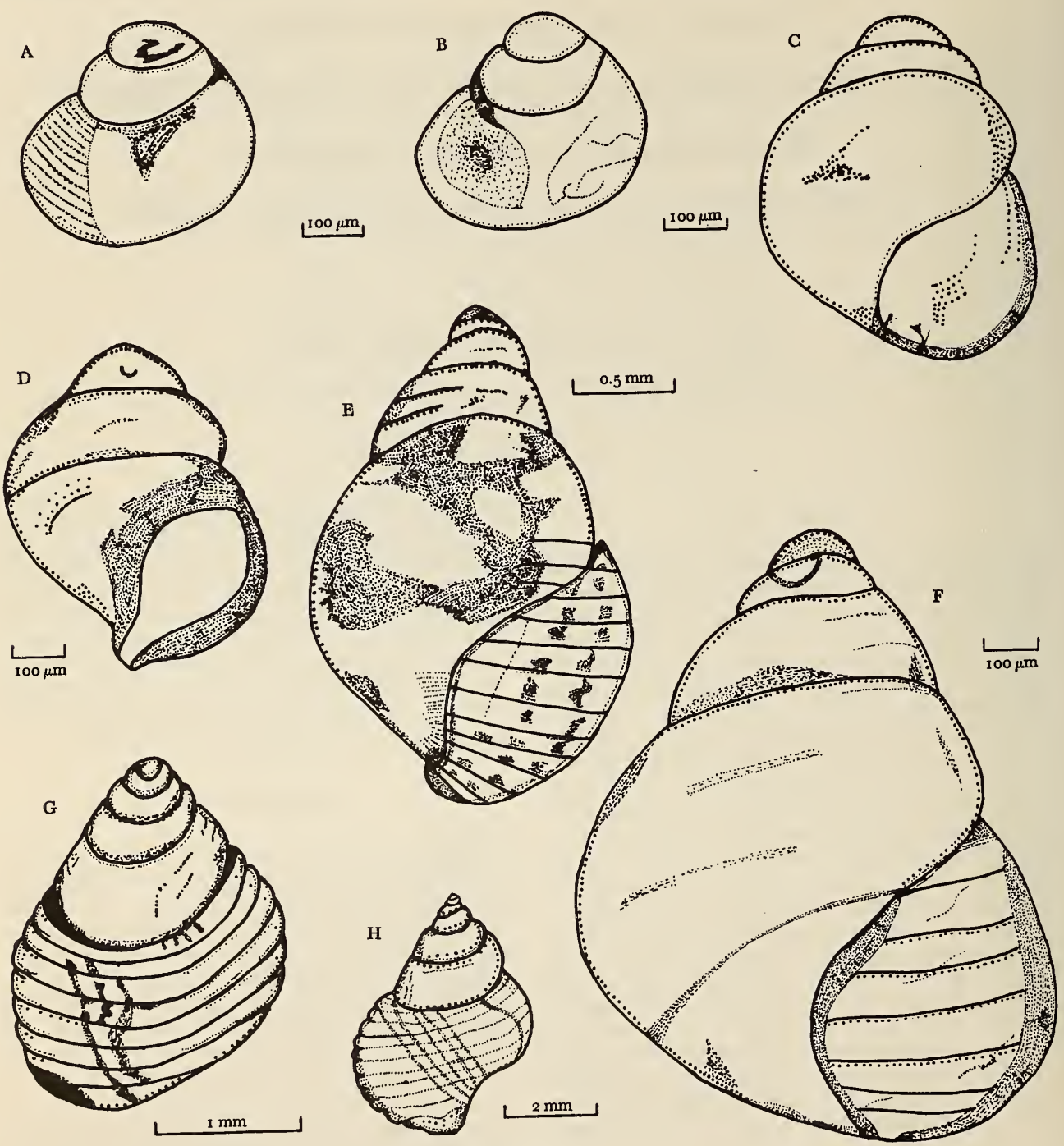

Figure *1*

Planaxis sulcatus. A. dorsal view of newly hatched fry; B. dorsal view of same, showing aperture of the shell; C. ventral view of 96 hrs fry; D. ventral view of 48 hrs old juveniles; E. ventral view of one and a half month old juvenile; F. ventral view of 480 hrs fry; G. dorsal view of two months and six days juvenile; H. dorsal view of seven months juvenile.

Brood Size: The number of juveniles hatched per snail varied from 167 to 596 with an average of 328. This wide range may be attributable to the reason that the specimens used were probably already in the process of hatching when collected. The mother specimens did not differ much in size (17.3 to 19.6 mm in height and 10.9 to 12.3 mm in width); thus the differences in the brood size may not be attributable to the size of the parent snails.

Shell Growth: At hatching the juvenile shell (Figures *1* A & B) is transparent and light brown in colour, has two and a half whorls and averages 376 μm in height (range: 353 to 388 μm). Incipient spiral ribs are present on the body whorl. The shell is sculptureless at this stage and the operculum is hard and dark brownish. Soon after hatching the young snails start crawling over the glass bottom with a well developed foot, which is provided with long tentacles having eyes at their base. Ultimately they reach the water surface and attach themselves just above the water level.

The juveniles thrived well for over seven months after hatching in the laboratory. Measurements of their shell growth and changes in whorl numbers are given in Table 1. After 24 hours of hatching, the spiral ribs became prominent, sutures between the whorls were also well defined and sculpturing on the body whorl was visible. Sculpturing of the body whorl became more prominent after 48 hours. The shell still had four whorls but grew in thickness. The fifth whorl was added to the shell 15 to 20 days after hatching (Figure *2* F). At this stage growth lines and sutures were well defined, axial ribs were evident and the colour of the shell turned darker. The six-whorls stage was reached in about two months time when the shell acquired thick walls, big body whorls, and a conical spire (Figure *1* G). Growth seemed to decrease from here onwards as the seventh whorl was added after another five months or so. The seven-whorl snails had somewhat rough outer surfaces and thick shell walls.

Specimens from Cape Monze and Keamari sea-wall also hatched in the laboratory. Slight variations in the growth rate of young snails belonging to different populations were noted but these did not differ significantly from those of the Buleji population.

Table 1

The number of whorls and dimensions of shells of the juveniles of *Planaxis sulcatus* at various stages of growth.

	At hatching	12 hrs.	24 hrs.	48 hrs.	480 hrs.	2 months	7 months
Av. no. whorls	2½	3	3 - 4	4	5	6	7
Av. shell height μm	376	410	449	509	1007	2990	5360
Range shell height μm	353 - 368	342 - 547	384 - 576	502 - 596	1003 - 1010	2700 - 3210	4560 - 5480

DISCUSSION

Ovoviviparity is a rare phenomenon in prosobranch gastropods (Anderson, 1960; Webber, 1977). It is a type of development in which eggs are retained within a brood chamber (pallial oviduct) until they are ready to hatch. Examples of ovoviviparous prosobranchs are *Planaxis sulcatus* (Thorson, 1940), *Thais haemostoma* and *Littorina saxatilis* (Linke, 1934 cited in Anderson, 1960), *Littorina angulifera* (Lebour, 1945), *Littorina scabra* (Struhsaker, 1966, Kojima, 1960), *Acmaea rubella* (Thorson, 1944) and *Nassarius albus* (Cather, 1973). Two types of ovoviviparity are known; in one the young are born as planktonic veligers for pelagic existence, whereas in the other they are born at a crawling stage for benthic existence. There are, however, instances of species which develop with pelagic larvae in one locality and with non-pelagic larvae feeding on nurse eggs in another locality. Out of the seven species mentioned above, four species, *P. sulcatus, L. angulifera, T. haemastoma* and *L. scabra* develop differently in different localities (Thorson, 1950; Mileikovsky, 1975). The remaining three species, namely, *L. saxatilis, N. albus* and *A. rubella* have been examined from one or two localities only (see Thorson, 1935; Cather, 1973; Mileikovsky, 1975). Hence nothing could be said about these species whether they exhibit more than one kind of development.

Planaxis sulcatus has also been described to hatch as crawling young in the Persian Gulf by Thorson (1940), who stated that the embryos break out of the egg membrane but remain in the uterus where they feed on other developing eggs and finally emerge as crawling young snails at a much greater size. Growth rates of juveniles after hatching have not been studied earlier in any ovoviviparous prosobranch. The results of the present study show that the juveniles of *P. sulcatus* measure on the average 376 μm on hatching and have two and a half whorls. They become 5 mm high after a growth of seven months acquiring seven whorls. The adults of this species normally show seven to eight whorls. Therefore, the snails reared in the laboratory had almost reached the adult stage. The young snails displayed a rapid growth rate and they would have grown much faster had they been provided with food.

The number of juveniles spawned during this study by *Planaxis sulcatus* varied from 167 to 596, which seems to be a high count compared to other viviparous species, for instance *Littorina saxatilis,* which was reported to have only 28 to 37 eggs inside the body (Lebour, 1937). Comparable counts on any other species of *Planaxis* are not available.

SUMMARY

The prosobranch gastropod *Planaxis sulcatus* breeds from January to August on the coast of Karachi in the northern Arabian Sea. It is viviparous. The number of juveniles released per individual varies from 167 to 596. The juveniles at hatching measure on the average 376 μm and their shells have two and a half whorls. They measure five millimeters in height after a growth of seven months in the laboratory.

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